

REMARKS

Applicants respectfully request reconsideration of the present application in view of the foregoing amendments and in view of the reasons that follow.

Claims 1-57 are now pending in this application. No claims were amended, added or cancelled.

I. Rejoinder requested

Claims 29-57 are withdrawn from consideration. Applicants respectfully request that claims 29-57 be rejoined with claim 1 upon allowance of claim 1 because independent claims 29 and 44 are narrower than claim 1 and contain every limitation of claim 1.

II. The 102(b) rejection should be withdrawn

Claims 1, 2 and 15 have been rejected under §102(b) as being anticipated by Shibata (U.S. Patent Number 6,505,670). This rejection is respectfully traversed.

Independent claim 1 recites “combining a first solid metal portion and a second liquid metal portion in a first chamber of an injection molding machine to form a semi-solid metal slurry.” Thus, claim 1 requires that a separate solid metal portion be combined with a separate liquid metal portion to form a semi-solid slurry. Shibata does not teach or suggest this limitation.

Shibata teaches melting solid metal into molten (i.e., liquid or semi-solid) metal in a furnace, then providing the molten metal into the shot sleeve, cooling the molten metal to the semi-solid state and then injecting the semi-solid metal into the mold. Specifically, Shibata discloses a method in column 9, line 16 to page 10, line 4, where molten aluminum 20 is provided from a holding furnace 10 into a casting sleeve 2 through feed pipe 8 (see col. 9, lines 16-17). The molten metal has a temperature between 10 °C below the liquidus and 40 °C above the liquidus (col. 7, lines 43-45). Thus, the molten metal is either in the liquid state when its temperature is above the liquidus or in the semi-solid state when its temperature is slightly below the liquidus. The molten aluminum 20 is allowed to cool and partially solidify

in the casting sleeve into the semi-solid state (col. 9, lines 52-58). The semi-solid aluminum is then injected by a plunger 5 into the mold from the shot sleeve 2 (col. 9, line 65 to col. 10, line 4).

At no point during the process of Shibata is a separate solid metal portion combined with a separate liquid metal portion, as recited in claim 1 of the present application. Col. 7, lines 39-50 of Shibata cited in the Office Action does not disclose combining solid and liquid metal. Instead, col. 7, lines 39-50 of Shibata discloses a single molten metal portion comprising metal in the semi-solid state or the liquid state which is provided into the sleeve.

The recitation in claim 1 of combining a first solid metal portion and a second liquid metal portion to form a semi-solid slurry is not the same as formation of the semi-solid metal of Shibata because in the method of Shibata, there is no step of combining solid and liquid metal portions to form the semi-solid metal. Instead, a portion of a liquid (or semi-solid) metal of Shibata is solidified into crystals to form the semi-solid metal. Thus, in the method of Shibata, liquid metal is converted to semi-solid metal and there is no step of combining liquid and solid metal portions to form the semi-solid metal. Thus, applicants respectfully submit that Shibata does not anticipate claims 1, 2 and 15.

III. The 103(a) rejections should be withdrawn

A. Rejection over Shibata and Apelain

Claims 4-14, 16 and 17 are rejected under § 103(a) as being unpatentable over Shibata in view of Apelain (US Patent Number 4,902,475). This rejection is respectfully traversed.

Apelain was relied upon in the Office Action for the teaching of aluminum grain refining agent composition in aluminum. However, Apelain does not teach or suggest combining a first solid metal portion and a second liquid metal portion in a first chamber of an injection molding machine to form a semi-solid metal slurry. Thus, Apelain does not remedy the deficiency of Shibata.

B. Rejection over Shibata and Nakao

Claims 3 and 18-28 are rejected under § 103(a) as being unpatentable over Shibata in view of Nakao (US Patent Number 6,505,670). This rejection is respectfully traversed.

Nakao teaches a method in which a solid aluminum billet 48 is combined with semi-solid aluminum 41 in an injection chamber 25. For example, col. 9, lines 5-13 of Nakao states that Al alloy 41 in the half-solidified state (i.e., the semi-solid state) is fed to the injection chamber 25 over a solid aluminum billet 48. Thus, a semi-solid metal contacts a solid metal billet.

However, Nakao does not teach or suggest a method in which a solid metal is combined with a liquid metal to form a semi-solid slurry, as recited in claim 1 of the present application.

Nakao also teaches that a molten metal matrix composite (i.e., Al and SiC) 42 is placed on top of the semi-solid aluminum 41 in the chamber 25. However, the metal matrix composite does not come into contact with the solid billet 48. In the method of Nakao, the billet 48 is first melted by the semi-solid aluminum 41. Then, the metal matrix composite 42 is provided over the semi-solid metal 41. Thus, the billet 48 is melted into the semi-solid aluminum 41 before the metal matrix composite 42 is provided into the chamber 25 (see col. 9, lines 5-24 and Figures 13-14 of Nakao).

Therefore, Nakao explicitly teaches to keep the solid billet 48 from coming into contact with the molten metal matrix composite 42.

Thus, even if there was motivation to combine Shibata and Nakao, the combination would not teach or suggest all claim limitations. Neither Shibata nor Nakao teach combining liquid and solid metal to form a semi-solid slurry. In fact, Nakao teaches not to contact the solid billet with the molten metal matrix composite. Therefore, even if Shibata and Nakao are combined, the combination would not teach or suggest combining liquid and solid metal to form a semi-solid slurry.

C. Claims 21-22

The Office Action states on page 5 that it is obvious to have a surface area to volume ratio of greater than 10:1 because it depends on the cast product. Applicants respectfully disagree.

Claims 21-22 recite a surface area to volume ratio of the second cavity portion that is used to form the third solid metal portion (i.e., the heat sink) that is provided back into the shot chamber. Thus, the second cavity portion is not used to form a product but a heat sink which is provided back into the shot chamber. Therefore, the dimensions of the second cavity portion recited in claims 20-21 do not depend on the cast product.

Applicants also note that Nakao teaches that it is necessary to press the billet 48 into a flat shape (see Figures 8-9 of Nakao) before melting the billet. In contrast, by forming the heat sink with the claimed high surface area ratio of claims 21-22 directly in the mold, the heat sink has a high surface area and the billet pressing step of Nakao can be avoided.

D. Claim 23

Claim 23 recites that the secondary cavity portion mentioned above contains fins or spikes. Thus, a finned or spiked heat sink is produced which is then provided back into the shot chamber. There is no teaching or suggestion in Nakao to make a finned or spiked heat sink.

E. Claims 25-26

The Office Action states on page 5 that it is obvious to have width at least two times greater than the depth because it depends on the cast product. Applicants respectfully disagree.

Claim 25 recites the dimensions of the shot chamber and the melt in the shot chamber, where the shot chamber width is at least twice the depth of the melt in the shot chamber. The dimensions of the shot chamber do not depend on the final cast product, since only the

dimensions of the mold cavity determine the shape and size of the final cast product. There is no teaching or suggestion in the applied prior art to use the shot chamber recited in claim 25.

Furthermore, as recited in claim 26, the slurry contains a globular or equiaxed primary phase microstructure without stirring the slurry when the shot chamber of claim 25 is used. There is no teaching or suggestion in the applied prior art to use the method recited in claim 26.

IV. Conclusion

Applicants believe that the present application is now in condition for allowance. Favorable reconsideration of the application as amended is respectfully requested. The Examiner is invited to contact the undersigned by telephone if it is felt that a telephone interview would advance the prosecution of the present application.

Respectfully submitted,

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By LR 

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The Commissioner is hereby authorized to charge any additional fees which may be required regarding this application under 37 C.F.R. §§ 1.16-1.17, or credit any overpayment, to Deposit Account No. 19-0741. Should no proper payment be enclosed herewith, as by a check being in the wrong amount, unsigned, post-dated, otherwise improper or informal or even entirely missing, the Commissioner is authorized to charge the unpaid amount to Deposit Account No. 19-0741. If any extensions of time are needed for timely acceptance of papers submitted herewith, Applicant hereby petitions for such extension under 37 C.F.R. §1.136 and authorizes payment of any such extensions fees to Deposit Account No. 19-0741.